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SOVIET CONFERENCE ON NEW DESIGNS FOR BUSBAR CONDUCTORS

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At the end of 1949, the Committee on Power Supply for Industrial Enterprises attached to VNITOE (All-Union Scientific and Technical Society of Power Engineers), in conjunction with MONITOE (Moscow Branch of VNITOE) and the House of Engineers and Technicians imeni Dzerzhinskiy, held a one-day conference of Moscow electrical engineers on new designs for busbar conductors for intrashop power distribution in metal-working shops where technological equipment is frequently moved.

The following three papers were read at the conference:

1. Engr G. A. Karvovskiy, Tsentroelektromontazh, MSPTI (Electrical Installation Trust for the Central Region, Ministry of Construction of Heavy Industry Enterprises) in his paper, "The Design of Plug Busbar Conductors," gave a critical review of the old systems of intrashop power distribution, which were based on calculations concerning the minimum of conducting material, and were built as radial networks and laid by methods which did not permit rapid removal (in trenches, conduits, and steel pipes).

The search for better methods was first conducted in a large automobile plant where metal boxes containing insulated leads supplied all voltages required by the machine lathes. The next important step was the introduction of Engr F. Ya. Gol'dberg's famous "busbar assemblies," which are still of value in some cases. Next came the changeover from cable radial-feed networks to the higher capacity main feeder networks made of bare wire or busbars designed according to the specific load method (a/m^2 or va/m^2), making allowances for possible shifting of equipment.

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Bare wire, main feeder networks are used in conjunction with so-called "plug" shielded busbar conductors. Although, in the design of such networks, application of the specific load method leads to substantial reserve capacity in the main network, in the long run this system results in some saving in conducting material. Plug busbar conductors can also be combined with enclosed busbar conductors for high currents (up to 2,000 amp). This results in a really universal, flexible and economical system of intrashop power distribution. It should be noted that the reliability of bare main feeder circuits has been confirmed by almost 15 years of operating experience in the most important shops of the metallurgical and machine-building industries.

Industrial designs of plug busbar conductors have now been developed and placed in operation, e.g., in shops of the Plant imeni Stalin, etc. At this plant, 600-amp plug busbar conductors were made and installed by the plant staff from sketches provided by the MPKU (Moscow Planning and Designing Administration) of Tsentroelektromontazh. The Moscow Plant for Electrical Installation Designs of Glavelektromontazh (Main Administration for Electrical Installation Work) MSPTI has mastered the production of 250 and 350-amp busbar conductors. This design differs somewhat from the MPKU TsKM (Tsentroelektromontazh) design used at the Auto Plant imeni Stalin. Basic features of the GKM (Glavelektromontazh) design were also used in designing the busbar conductors manufactured at present by the production shops of Glavelektroprommontazh /Main Administration for Installation Work in the Electrical Industry?/ of Minmashstroy (Ministry of Machine and Instrument Building). These busbar conductors are made for working currents of 100, 250 and 350 amp.

To obtain a flexible system of intrashop power distribution, the wide use of plug busbars is recommended, especially in areas where cranes are not installed, in which case the busbars can be disposed along the lines of probable machine tool location and secured either to the roof or to special girders. Plug busbar conductors should also find application in shops with crane spans. In these cases, the conductors should be located in the "dead" zones of the crane spans, i.e., along the columns of the building below the joists underneath the crane.

The introduction of busbar conductors designed according to specific /unit/ load calculations presents extensive opportunities for preserving their universality over an operational period of unlimited duration and at the same time permits the installation of low voltage static condensers for power factor improvement while the network is already in use.

2. Engr P. P. Karochkin (Auto Plant imeni Stalin) in his report, "Experience in Manufacturing and Utilizing Plug Busbar Conductors," stated that his plant had manufactured, installed and now operates 500 m of plug busbars. They were made in accordance with the drawings of MPKU TsKM (Type B) and have the following characteristics: rated current 600 amp, taps with fuses up to 100 amp, length of section 2 m, weight of section (without tap boxes) 30 kg. The plug (tap) boxes can be installed along both sides of the busbar conductor at intervals of 0.25 meters. The plant now has all the equipment required for manufacturing these busbars. Two months' operating experience with the first batch of busbar conductors enables the following conclusions to be made:

a. Most of the troubles and breakdowns which took place when the busbar conductors were first put into operation were due to the complexity of the installation conditions (they were installed without interrupting production) and "teething troubles" in familiarization with new parts. After the initial period, the conductors worked without a single breakdown.

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b. Some of the troubles were due to the as yet insufficient development of individual elements of the design of the busbar conductors; e.g., the bolted joints used for the separate sections did not assume reliable electrical contact along the whole length of the busbar conductor box; the distances from the current leads to the frame in the tap boxes were insufficient; the heat resistance of the knife switches installed in the tap boxes was insufficient, etc.

c. The use of plug busbar conductors results in great operational convenience, and for this reason the plant intends to fit them in a number of shops.

Concerning the electric supply system of shops using plug busbar conductors and bare main feeders as a whole, from an operational standpoint, the speakers expressed the following wishes:

a. To keep account of the power in shops and departments it is necessary to work out a design for installing current transformers in series with the busbars.

b. Steps should be taken to explore the advisability of not using the busbar housing as a main-feeder ground conductor and, instead, using a separate ground for this purpose.

c. If automatic machines are installed in places where taps are taken from bare or covered feeders to plug-busbar conductors, their motor circuits should have sufficient time lag to prevent premature power cutoff, particularly in the case of short circuits occurring in the vicinity of the automatically controlled motors, as was confirmed experience of the Plant imeni Stalin. The time delay should be of sufficient duration to permit the fuses in the motor circuits to blow, if necessary.

d. For individual lighting of the machines, the power network should be replaced by a group lighting system from an independent current source (a small step-down transformer for a group of machine tools) with a distribution network installed specially for this purpose.

e. The use of open bare main feeders should be permitted only in cases where it does not interfere with the execution of repair work in the shop.

3. Engr S. V. Frenkel' (Glavelektroprommontazh) in his paper, "Experience of Manufacturing and Installing Plug Busbars Conductors," gave a detailed account of the design of busbar conductors now being made by the production shops of Glavelektroprommontazh. The range is as follows: (1) distribution-type 3-meter sections for 100, 250 and 300 amp; (2) branch (plug) boxes up to 100 amp; and (3) transitional elements (fittings) of three types: angle, cross, and three-way piece.

In addition to the above, the shops are producing main feeder busbar conductors for currents of 500 and 700 amp of the blank type without plug branches. Power is tapped by installing cable branch boxes where the sections butt, or by changing over to a distribution section by means of a suitable fitting. Double busbars are used for the main feeder busbar conductors. This arrangement increases the dynamic stability with respect to short-circuit current and reduces the induced voltage drop.

Thus, the range of parts for busbar conductors now being produced is quite sufficient for designing a "transformer -- main feeder" unitized system for transformers up to 1,000 kva (where power is tapped from both sides of the transformer). But such busbar conductors afford only a partial solution to

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the problem of intrashop power distribution, since they can, in essence, be used only as distribution equipment in production-line technology. Work is in progress on making plug busbars for higher currents.

In the process of arranging for the production of busbar conductors it was necessary first, to master the manufacture of small, filled /replaceable insert/ fuses, which involves fairly complex manufacturing technology; and second, to overcome the difficulties of high-quality painting of busbars.

The production of the first batch of busbars revealed a number of design and manufacturing flaws, which are presently being corrected. In particular, tests showed that the busbars have considerable inductance, which substantially lowers the value of the short-circuit current as early as the first sections. Moreover, fluctuations in busbar impedance are as high as 35 percent, which raises the problem of transposition.

The problem of grounding the busbar boxes and branch plug boxes is still unsolved. The recommended strengthening of busbar sections by so-called "Suratch" /lock-washery/ nuts hardly assures the necessary contact.

In conclusion, the speaker proposed the following measures: Glavelektromontazh and Glavelektroprommontazh designs, with which the industry was familiar, should be accepted as standard for industrial enterprises; the problem of the planned supply of materials for busbar manufacture should be solved; work on improving existing types of busbars should be extended and all planning organizations should be advised to use accepted designs of busbars in their own designs, while extending the field of application of the "unitized transformer -- main feeder" system as much as possible.

In the discussion which ensued, unanimous approval was given to measures for the introduction of finished systems of intrashop power distribution into planning and installation practice, and the use of plug busbar conductors as fully satisfying present-day operational requirements in large machine shops where the equipment layout is frequently altered.

Problems mentioned in the papers and the discussion were reflected in the resolution which was passed.

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